

EUROPEAN
TELECOMMUNICATION
STANDARD

DRAFT
pr **ETS 300 680-1**

October 1995

Source: ETSI TC-RES

Reference: DE/RES-09021-1

ICS: 33.020, 30.060.20

Key words: EMC, test, radio communications equipment, CB radio

**Radio Equipment and Systems (RES);
Electro-Magnetic Compatability (EMC) standard for
Citizen's Band (CB) radio and ancillary equipment
(speech and/or non-speech)
Part 1: Angle-modulated**

ETSI

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Foreword

This European Telecommunication Standard (ETS) has been prepared by the Radio Equipment and Systems (RES) Technical Committee of the European Telecommunications Standards Institute (ETSI), and is now submitted for the Public Enquiry phase of the ETSI standards approval procedures.

This ETS is based upon the Generic Standards EN 50081-1 [1] , EN 50082-1 [2], and other standards where appropriate, to meet the essential requirements of 89/336/EEC "Council Directive of 3 May 1989 on the approximation of laws of Member States relating to Electromagnetic Compatibility".

Proposed transposition dates	
Date of latest announcement of this ETS (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

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1 Scope

This ETS, together with the appropriate product standard for the effective use of the radio spectrum, covers the assessment of Citizen's Band (CB) radio and ancillary equipment in respect of Electro-Magnetic Compatibility (EMC). Technical specifications related to the antenna port, and emissions from the enclosure port of CB Radio equipment, are not included in this ETS. Such technical specifications are found in the related product ETS.

This ETS specifies the applicable EMC tests, the test methods, the limits and the minimum performance criteria for CB Radio equipment (speech and/or non-speech) operating in the frequency range 26 MHz - 28 MHz, and the associated ancillary equipment.

The environmental classification used in this ETS refers to the environment classification used in the Generic Standards EN 50081-1 [1], EN 50082-1 [2], except for the vehicular environment class which refers to ISO 7637 [11].

The EMC requirements have been selected to ensure an adequate level of compatibility for apparatus at residential, commercial, light industrial and vehicular environments. The levels do not cover extreme cases which may occur in any location but have a low probability of occurrence.

This ETS may not cover those cases where a potential source of interference which is producing individually repeated transient phenomena or a continuous phenomena is permanently present, e.g. a radar or broadcast site in the near vicinity. In such a case it may be necessary to use special protection applied to either the source of interference or the interfered part or both.

Compliance of radio equipment to the requirements of this ETS does not signify compliance to any requirements related to the use of the equipment (i.e. licensing requirements).

Compliance to this ETS does not signify compliance to any safety requirements. However, it is the responsibility of the assessor of the equipment that any observations regarding apparatus becoming dangerous or unsafe as a result of the application of the tests of this ETS, should be recorded in the test report.

2 Normative references

This ETS incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and relate to the publications listed hereafter. For dated references, subsequent amendments to, or revisions of, any of these publications apply to this ETS only when incorporated in it by amendment or revision. For all references, the latest edition of the publication referred to applies.

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|-----|--|
| [1] | EN 50081-1: "Electromagnetic compatibility - Generic emission standard; Part 1: Residential, commercial and light industry". |
| [2] | EN 50082-1: "Electromagnetic compatibility - Generic immunity standard; Part 1: Residential, commercial and light industry". |
| [3] | EN 55022: "Limits and methods of measurement of radio interference characteristics of information technology equipment". |
| [4] | CISPR. Publication No. 16-1: "Specification for radio disturbance and immunity measuring apparatus and methods". |
| [5] | ENV 50140: "Basic immunity standard - Radiated, radio frequency, electromagnetic fields". |
| [6] | EN 61000-4-2: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge immunity test". |
| [7] | EN 61000-4-4: Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 4: Electrical fast transients/burst immunity test". |

- [8] ENV 50141: "Basic immunity standard - Conducted disturbances induced by radio-frequency fields".
- [9] EN 61000-4-11: Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 11: "Voltage dips, short interruptions and voltage variations immunity tests".
- [10] EN 61000-4-5: Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 5: Surge immunity tests".
- [11] ISO 7637: "Road vehicles-Electrical disturbance by conducting and coupling"; Part 1: "Passenger cars and light commercial vehicles with nominal 12 V supply voltage" and Part 2: "Commercial vehicles with nominal 24 V supply voltage - Electrical transient conduction along supply lines only".

3 Definitions

For the purposes of this ETS, the following definitions apply:

radiocommunications equipment: An item of radio equipment is an apparatus which includes one or more transmitters and/or receivers and/or parts thereof. This type of equipment (apparatus) is used in a fixed, mobile or a portable application.

ancillary equipment: Equipment (apparatus), used in connection with a receiver, transmitter or transceiver is considered as an ancillary equipment (apparatus) if:

- the equipment is intended for use in conjunction with a receiver, transmitter or transceiver to provide additional operational and/or control features to the radio equipment (e.g. to extend control to another position or location); and
- the equipment cannot be used on a stand alone basis to provide user functions independently of a receiver, transmitter or transceiver; and
- the receiver, transmitter or transceiver to which it is connected, is capable of providing some intended operation such as transmitting and/or receiving without the ancillary equipment (i.e. it is not a sub unit of the main equipment essential to the main equipment basic functions).

port: A particular interface of the specified equipment (apparatus) with the external electromagnetic environment.

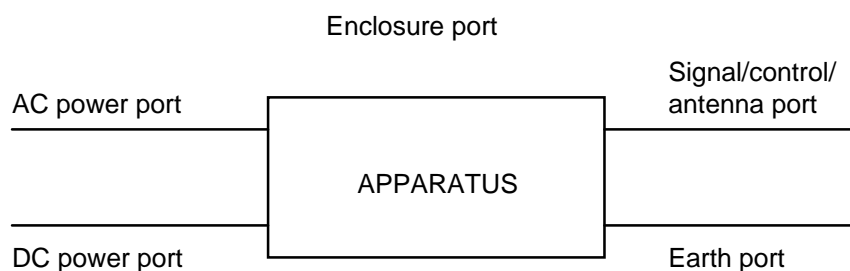


Figure 1: Examples of a port

enclosure port: The physical boundary of the apparatus onto which an electromagnetic field may radiate or impinge.

integral antenna equipment: In the context of this ETS integral antenna CB equipment is CB equipment without an assessable external transmission line interface.

Integral antenna CB equipment in the context of this ETS should be understood to be low power handheld CB radio equipment which is mainly used for children's toys and similar purposes.

switching range: The switching range is the maximum frequency range over which the equipment can be operated without reprogramming or realignment.

4 General test conditions

4.1 Test conditions

This subclause defines the requirements for the general test configuration and are as follows:

- the equipment shall be tested under conditions which are within the manufacturers declared range of humidity, temperature and supply voltage;
- the test configuration shall be as close to normal intended use as possible;
- integral antenna CB equipment shall be tested in a manner typical of normal intended use;
- if the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment while connected to the minimum configuration of ancillary equipment necessary to exercise the ports;
- ports which in normal operation are connected shall be connected to an ancillary equipment or to a representative piece of cable correctly terminated to simulate the impedance of the ancillary equipment, RF input/output ports shall be correctly terminated;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operation conditions and to ensure that all the different types of termination are tested;
- ports which are not connected to cables during normal intended operation, e.g. service connectors, programming connectors, temporary connectors etc. shall be connected to any cables for the purpose of EMC testing. Where cables have to be connected to these ports, or interconnecting cables have to be extended in length in order to exercise the EUT, precautions shall be taken to ensure that the evaluation of the EUT is not affected by the addition or extension of these cables;
- the tests shall be carried out at a point within the specified normal operating environmental range at the rated supply voltage for the equipment;
- the test conditions, test configuration and mode of operation shall be recorded in the test report.

4.1.1 Emission tests

This subclause defines the requirements for the emissions test configuration and are as follows:

- the measurement shall be made in the operation mode producing the largest emission in the frequency band being investigated consistent with normal applications;
- an attempt shall be made to maximise the detected radiated emission for example by moving the cables of the equipment.

The CB radio equipment shall be operated on one channel frequency, which is close to the middle of the switching range declared by the manufacturer.

4.1.2 Immunity tests

This subclause defines the requirements for the immunity test configuration and are as follows:

- the measurement shall be made in the mode of operation as required in subclause 4.1.2.1;
- for the immunity tests of ancillary equipment without a separate pass/fail criteria, the receiver, transmitter or transceiver coupled to the ancillary equipment, shall be used to judge whether the ancillary equipment passes or fails;
- immunity tests on CB radio equipment shall be carried out on one channel which is close to the middle of the switching range declared by the manufacturer.

4.1.2.1 Mode of operation

For the immunity tests of transmitters, the transmitter shall be operated at its maximum RF output power, or at a level not less than to - 6 dB relative to that power level in the event of declared thermal limitations. The transmitter is modulated with normal test modulation (subclauses 4.1.2.2 and 4.1.2.3). A communication link shall be established (subclause 4.1.2.4) at the start of the test

For the immunity tests of receivers, the wanted input signal, coupled to the receiver, shall be modulated with normal test modulation (see subclauses 4.1.2.2 and 4.1.2.5). A communication link shall be established (see subclause 4.1.2.6) at the start of the test.

4.1.2.2 Normal test modulation

For analogue speech applications:

- the receiver wanted input signal shall be set to the nominal frequency of the receiver modulated with a sinusoidal audio frequency of 1000 Hz. The wanted test signal shall have an FM deviation of at least 1,2 kHz;
- the transmitter of the EUT shall be modulated with a sinusoidal audio frequency signal of 1000 Hz. The level of this audio signal shall be adjusted to obtain at least 1,2 kHz FM peak deviation.

For non speech applications:

- the receiver wanted input signal shall be set to the nominal frequency of the receiver modulated with a test signal specified by the manufacturer which represent normal operation;
- the transmitter shall be modulated with a test signal which represents normal operation as specified by the manufacturer.

The test signal generator (modulation) shall be able to produce a continuous stream of data or a repetitive message.

The test signal receiver (demodulator) shall be able to produce a readout of BER of a continuous data stream or a repetitive readout of message acceptance.

4.1.2.3 Arrangements for test signals at the input of the transmitter

The transmitter should be modulated with normal test modulation.

4.1.2.4 Arrangements for test signals at the output of the transmitter

For integral antenna CB equipment, the wanted signal, to establish a communication link, shall be delivered from the equipment to an antenna located within the test environment. The measuring equipment for the wanted signal shall be located outside of the test environment. Adequate measures shall be taken to avoid the effect of the unwanted signal on the measuring equipment.

For equipment with an external coaxial antenna connector (non-integral antenna CB equipment), the wanted signal to establish a communication link shall be delivered from the antenna connector by a coaxial cable. The measuring equipment for the wanted signal shall be located outside of the test environment. Adequate measures shall be taken to avoid any effect of the unwanted signal on the measuring equipment.

4.1.2.5 Arrangements for test signals at the input of the receiver

For integral antenna CB equipment, the wanted input signal, to establish a communication link, shall be presented to the equipment from an antenna located within the test environment. It shall be approximately 40 dB above the minimum level necessary to achieve normal operation performance, as declared by the manufacturer, measured while the power amplifiers generating the EMC disturbance are switched on but without excitation. This level of the wanted input signal is expected to represent normal operation signal

level and is sufficient to avoid the broad band noise from the power amplifiers, from influencing the measurement. The source of the wanted input signal shall be located outside of the test environment.

For equipment with an external coaxial antenna connector (non-integral antenna CB equipment), the wanted input signal to establish a communication link shall be presented to the antenna connector by a coaxial cable. The source of the wanted input signal shall be located outside of the test environment and shall be at a nominal value of 40 dB μ V emf.

4.1.2.6 Arrangements for test signals at the output of the receiver

For speech equipment the audio frequency output of the equipment should be coupled via a suitable coupling device in order to demonstrate that the communication link is maintained. Precautions shall be taken to ensure that any effect on the test is minimized.

For non-speech equipment the output of the receiver shall be coupled via a suitable coupling device in order to demonstrate that the communication link is maintained. Precautions shall be taken to ensure that any effect on the test is minimized.

4.1.2.7 Receiver and receivers of transceivers exclusion band

The exclusion band for receivers and receivers of transceivers is the frequency range determined by the switching range, as declared by the manufacturer, extended as follows:

- the lower frequency of the exclusion band is the lower frequency of the switching range, minus 5 % of the centre frequency of the switching range;
- the upper frequency of the exclusion band is the upper frequency of the switching range, plus 5 % of the centre frequency of the switching range.

4.1.2.8 Transmitter exclusion band

The exclusion band for transmitters extends ± 25 kHz from the nominal operating frequency of the transmitter.

4.1.2.9 Narrow band responses on receivers and receivers of transceivers

Responses on receivers or receivers of transceivers occurring during the test at discrete frequencies which are narrow band responses (spurious responses), are identified by the following method.

If during the test an unwanted signal creates a degradation of the audio or data output, it is necessary to establish whether the degradation is due to a narrow band response or to a wide band phenomena. Therefore, the unwanted signal frequency is increased by an amount equal to twice the bandwidth of the receiver IF filter immediately preceding the demodulator, as declared by the manufacturer. The test is repeated with the frequency of the unwanted signal decreased by the same amount.

If the degradation disappears, then the response is considered as a narrow band response. If the degradation remains, this may be due to the fact that the offset has made the frequency of the unwanted signal correspond to the frequency of another narrow band response. Under these circumstances the procedure is repeated with the increase and decrease of the frequency of the unwanted signal adjusted two and one half times the bandwidth previously referred to.

If a degradation remains, the phenomena is considered as a wide band phenomena and therefore an EMC problem. If the degradation is in excess of the maximum permissible degradation, the equipment fails the test.

Narrow band responses shall be disregarded.

5 Performance assessment

5.1 General

Any instance of the EUT becoming unsafe or dangerous during the tests shall be recorded in the test report.

If the performance criteria specified in the tables 1 and 2 (subclause 6.1) are not appropriate, the manufacturer shall declare a substituted specification for an acceptable performance level or performance degradation as required by this ETS. The performance specification shall be included in the test report and the product description and documentation. The performance criteria specified by the manufacturer shall give the same degree of immunity protection as called for in subclauses 6.1, 6.2 and 6.3.

The manufacturer shall at the time of submission of the equipment for test, supply the following information to be recorded in the test report:

- the primary user functions of the radio equipment (see clause 6) to be tested during and after the EMC testing;
- the intended functions of the radio equipment which shall be in accordance with the documentation accompanying the equipment;
- the type of modulation, the characteristics of the transmission used for testing (random bit stream, message format, etc.);
- the ancillary equipment to be combined with the radio equipment for testing (where applicable);
- an exhaustive list of ports, classified as either power or signal/control. Power ports shall further be classified as ac or dc power;
- the bandwidth of the receiver IF filter immediately preceding the demodulator;
- the applicable equipment class according to subclause 6.1;
- the ac/dc power converter to be used with the EUT (if any).

5.2 Ancillary equipment

At the manufacturers discretion an ancillary equipment may be:

- declared compliant separately (in isolation) from a receiver, transmitter or transceiver to all the applicable immunity and emission clauses of this ETS;
- declared compliant to another appropriate EMC standard;
- tested while connected to a receiver, transmitter or transceiver in which case compliance shall be demonstrated to the appropriate clauses of this ETS and of the related product standard.

In the case of ancillary equipment, which does not permit a communications link to be established or in the case of ancillary equipment tested separately from other equipment, not connected to radio equipment, the manufacturer shall define the method of test to determine the acceptable level of performance or degradation of performance during and/or after the test.

The performance assessment carried out, shall be simple, but at the same time give adequate proof that the primary functions of the equipment are operational.

5.3 Equipment EMC environment classification

Equipment intended for use in more than one EMC environment, shall be tested with each type of declared power source, under conditions simulating each declared EMC environment.

For example, portable, base station or mobile equipment or combinations of equipment declared as capable of being powered for intended use by the main battery of a vehicle, shall additionally be considered as a vehicular mobile equipment.

Portable or mobile equipment or combinations of equipment declared as capable of being powered by ac mains shall additionally be considered as a base station equipment.

6 Performance criteria

CB radio equipment may contain user functions which are of primary relevance from the point of view of conveying information or configure the equipment to allow the exchange of information.

In addition other user functions may be included in the equipment which do not have a functional relationship with the primary function.

From the perspective of developing intrinsic immunity specifications (minimum performance criteria) the example below illustrates what is considered as primary and secondary user functions.

EXAMPLE:

- a CB radio receiver also containing an alarm clock:
 - primary user functions are the reception of CB radio transmissions, or decoding of selective calls, if provided;
 - secondary user functions are all functions related to the alarm clock.

Primary user functions:

- the equipment shall meet the minimum particular performance criteria as specified in the following subclauses 6.1, 6.2, 6.3, and 6.4 where appropriate.

Secondary user functions:

- for secondary user functions the equipment shall meet the general performance criteria as specified by the manufacturer (see subclause 5.1).

6.1 General performance criteria

The product family of CB radio equipment is divided into 2 classes of equipment, each having its own set of minimum performance criteria.

Class 1 of CB radio equipment is all kind of CB equipment except integral antenna CB equipment.

Class 2 of CB radio is integral antenna CB equipment used for portable applications.

Class 1 equipment shall meet the performance criteria as given in table 1 including the associated notes 1 and 2.

Class 2 equipment shall meet the performance criteria as given in table 2 including the associated note.

The establishment of the communication link at the beginning of the test, it's maintenance and the assessment of the recovered signal are used as the performance criteria for the evaluation of the primary functions of the equipment during and after the test.

The performance criteria A, B and C as indicated in table 1 shall be used in the following manner:

- performance criteria A for immunity tests with phenomena of a continuous nature;
- performance criteria B for immunity tests with phenomena of a transient nature including short voltage dips;
- performance criteria C for immunity tests with voltage dips and power interruptions exceeding a certain period of time.

Table 1: Performance criteria for class 1 equipment

During test	After test	Criteria
Operate as intended; Degradation of performance (note 1); No loss of primary user functions or stored data; No unintended RF transmission.	Operate as intended; No degradation of performance (note 2); No loss of function; No loss of stored data.	A
Loss of function (one or more); No unintended RF-transmission; No loss of primary user functions or stored data.	Operate as intended; No degradation of performance (note 2); Lost functions self-recoverable.	B
Loss of function (one or more) and/or user data; No unintended RF-transmission.	Operate as intended; No degradation of performance (note 2); Lost functions recoverable by the operator, either automatically or by operation of user control (as declared by the manufacturer).	C
<p>NOTE 1: For non-integral antenna CB radio equipment the degradation of performance during the test is specified by the maximum permissible degradation of performance (see also subclauses 5.1 and 6.2). If the maximum permissible degradation of performance is not specified by the manufacturer then this may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p> <p>NOTE 2: No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance (see also subclause 5.1). After the test no change of actual operating data or user retrievable data is allowed. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.</p>		

Table 2: Performance criteria for class 2 equipment

During test	After test	Criteria
Loss of function (one or more); No unintended RF transmission; No unintended function.	Operate as intended; Lost functions self-recoverable; No degradation of performance (note).	A, B
Loss of function (one or more); No unintended RF-transmission; No unintended function.	Operate as intended; No degradation of performance (note); Lost functions recoverable by the operator, either automatically or by operation of user control (as declared by the manufacturer).	C
NOTE : For integral antenna CB equipment no degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance (see also subclause 5.1). If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.		

A portable equipment powered by the battery in a vehicle shall additionally fulfil the applicable requirements set out by this ETS for the vehicular mobile equipment.

A portable or mobile equipment powered by ac mains shall additionally fulfil the applicable requirements set out by this ETS for base station equipment, although the tests performed are only those applicable to the input/output arrangements of the equipment, the performance criteria will remain as the original class for the equipment.

6.2 Specific performance criteria for continuous phenomena applied to transmitters and receivers

In addition to the performance criteria in tables 1 and 2 the following specific performance criteria for continuous phenomena for transmitters and receivers apply (performance criteria A):

For class 1 speech equipment (non-integral antenna CB equipment), the SINAD ratio of the audio signal shall be measured during each individual exposure in the test sequence and shall not be lower than 12 dB. The frequency response of the SINAD measurement equipment shall be within the limits of ± 3 dB in the frequency range 100 Hz to 10 kHz.

Class 1 non-speech equipment shall receive four messages out of five or 80 % of the transmitted symbols.

At the conclusion of the test the EUT class 1 equipment shall operate as intended with no loss of primary and secondary user functions or stored data, and the communication link shall have been maintained during the test.

For class 2 equipment the communication link may have been lost during the test.

Where the EUT is a transmitter only, tests shall be repeated with the EUT in keyed down and/or stand-by mode to ensure that unintentional transmission does not occur.

6.3 Specific performance criteria for transient phenomena applied to transmitters and receivers including short voltage dips

In addition to the performance criteria in tables 1 and 2 the following specific performance criteria for transient phenomena for transmitters and receivers apply (performance criteria B):

At the conclusion of each exposure the class 1 equipment shall operate with no user noticeable loss of the communication link.

For class 1 equipment, at the conclusion of the total test comprising the series of individual exposures the EUT shall operate as intended with no loss of primary and secondary user functions or stored data, as declared by the manufacturer, and the communication link shall have been maintained.

For class 2 equipment the communication link may have been lost during the test. Primary and secondary user functions, which are lost during the test, shall be recoverable by operating the user control or reset functions.

6.4 Specific performance criteria for long voltage dips and power interruptions applied to transmitters and receivers

For long voltage dips and for power interruptions (see subclause 9.4.2.4) the following performance criteria apply in addition to subclause 6.3 (performance criteria C):

- during and after the test there shall be no unintended transmission;
- during the test the communications link may be lost and one or more functions and/or stored user data may be lost;
- after the test the communications link shall be recoverable either automatically or by operational user control as declared by the manufacturer;
- after the test the speech quality level shall return to a level not below that specified by the manufacturer and the digital throughput shall return to its nominal value.

7 Applicability overview tables

7.1 Emission

Table 3: Emission overview

Port	Equipment test requirement			Reference subclause in this ETS	Reference document
	Base station and ancillary for fixed use	Mobile and ancillary for vehicular use	Portable and ancillary for portable use		
Enclosure port of an ancillary tested separately from other equipment	applicable	applicable	applicable	8.1	EN 55022 [3]
DC power input/output port	applicable	applicable	not applicable	8.2	EN 55022 [3] CISPR 16-1 [4]
AC mains power input/output port	applicable	not applicable	not applicable	8.3	EN 55022 [3]

7.2 Immunity

Table 4: Immunity overview

Phenomena	Application	Equipment test requirement			Reference clause in this ETS	Reference document
		Base station and ancillary for fixed use	Mobile and ancillary for vehicular use	Portable and ancillary for portable use		
RF electromagnetic field 80 -1000 MHz	Enclosure, radio equipment with or without ancillary connected	applicable	applicable	applicable	9.2	ENV 50140 [5]
Electrostatic discharge	Enclosure	applicable	applicable	applicable	9.2	EN 61000-4-2 [6]
Fast transient common mode	Signal/control/ antenna ports, dc and ac power input ports	applicable	not applicable	not applicable	9.3, 9.4, 9.5	EN 61000-4-4 [7]
RF common mode 0,15 - 80 MHz	Signal/control/ antenna ports, dc and ac power input ports	applicable	applicable	not applicable	9.3, 9.4, 9.5	ENV 50141 [8]
Voltage dips and interruptions	ac mains power input ports	applicable	not applicable	not applicable	9.4	EN 61000-4-11 [9]
Surges common and differential mode	Signal ports and ac mains power input ports	applicable	not applicable	not applicable	9.4	EN 61000-4-5 [10]
Vehicular environment transients and surges	DC power input port for vehicular use	not applicable	applicable	not applicable	9.6	ISO 7637 Parts 1 and 2 [11]

8 Test methods and limits for emission tests

8.1 Enclosure port of ancillary equipment tested separately from other equipment

8.1.1 Definition

This test assesses the ability of ancillary equipment to limit unwanted emissions from the enclosure.

This test is applicable to ancillary equipment tested separately from other equipment i.e. not connected to the radio equipment.

This test shall be performed on a representative configuration of the ancillary equipment.

8.1.2 Method of measurement:

The test method shall be in accordance with EN 55022 [3].

8.1.3 Limits

The value of the limits from EN 55022 [3] (10 m measuring distance) shall be used for ancillary equipment tested separately from other equipment.

Table 5: limits for unwanted emissions for ancillary equipment tested separately from other equipment

Clause	Frequency range	Limit (quasi-peak)	Basic standard
8.1.3.1	30 - 230 MHz	30 dB μ V/m	EN 55022 [3]
8.1.3.2	> 230 - 1 000 MHz	37 dB μ V/m	EN 55022 [3]

8.2 Emission: DC power input/output port**8.2.1 Definition**

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to limit internal noise from the dc power input ports.

8.2.2 Method of measurement

This test is applicable to equipment which may have dc cables longer than three (3) m.

This test shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

The test method shall be in accordance with EN 55022 [3] and the Line Impedance Stabilising Networks (LISNs) shall be connected to a dc power source.

The equipment shall be installed with a ground plane as defined in EN 55022 [3], subclause 9.3. The reference earth point of the LISNs shall be connected to the reference ground plane with a conductor as short as possible.

The measurement receiver shall be in accordance with the requirements of Section one of CISPR Publication 16-1 [4].

The measurement frequency range extends from 150 kHz to 30 MHz, excluding the transmitter exclusion band in TX mode.

The equipment shall meet the limits below (including the average limit and the quasi-peak limit) when using, respectively, an average detector receiver and a quasi-peak detector receiver and measured in accordance with the method described in subclause 8.2.2. If the average limit is met when using a quasi-peak detector, the equipment shall be deemed to meet both limits and measurement with the average detector receiver is unnecessary.

8.2.3 Limits

The limits given in table 6 apply.

Table 6: Limits

Clause	Environmental phenomena	Frequency range	Test limits	Basic standard
8.2.3.1	Conducted emission	0,15 - 0,5 MHz	66 - 56 dB μ V quasi peak 56 - 46 dB μ V average	EN 55022 [3]
8.2.3.2	Conducted emission	0,5 - 5 MHz	56 dB μ V quasi peak 46 dB μ V average	EN 55022 [3]
8.2.3.3	Conducted emission	5 - 30 MHz	60 dB μ V quasi peak 50 dB μ V average	EN 55022 [3]
NOTE: The limit decreases linearly with the logarithm of frequency in the range 0,15 MHz to 0,50 MHz. Equipment with a dc power input port declared for use with a dedicated ac/dc power adapter shall be tested on the ac power input of a typical ac/dc power adapter as specified by the manufacturer.				

The limits in table 6 apply for all modes of operation of the EUT.

8.3 Emission: AC mains power input/output port

8.3.1 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to limit internal noise from the ac mains power input/output ports.

8.3.2 Method of measurement

This test is applicable to equipment powered by the ac mains. This test shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

The test method shall be in accordance with EN 55022 [3].

In TX mode, the transmitter shall be operated to obtain its maximum peak envelope power. A single tone or bitstream shall be used to modulate the transmitter according to subclause 4.1.2.2.

The measurement frequency range extends from 150 kHz to 30 MHz, excluding the transmitter exclusion band when measured in the Tx mode (see subclause 4.1.2.8).

8.3.3 Limits

The limits of table 7 apply to all modes of operation of the EUT.

Table 7: Limits

Clause	Environmental phenomena	Frequency range	Test limits	Basic standard
8.3.3.1	Conducted emission	0,15 - 0,5 MHz	66 - 56 dB μ V quasi peak 56-46 dB μ V average	EN 55022 [3]
8.3.3.2	Conducted emission	0,5 - 5 MHz	56 dB μ V quasi peak 46 dB μ V average	EN 55022 [3]
8.3.3.3	Conducted emission	5 - 30 MHz	60 dB μ V quasi peak 50 dB μ V average	EN 55022 [3]

9 Test methods and limits for immunity tests

9.1 Test configuration

Immunity tests according to the following subclauses 9.1 to 9.6 shall be performed with the EUT successively set to all modes of operation available in the EUT.

9.1.1 Immunity: Enclosure port

9.1.2 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in presence of a radio frequency electromagnetic field and electrostatic discharges at the enclosure.

This test is applicable for base station, mobile, portable and ancillary equipment.

This test shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment or a representative configuration of the ancillary equipment tested in isolation.

9.1.3 Method of measurement

9.1.3.1 Radio frequency electromagnetic field

The test method shall be in accordance with ENV 50140 [5].

The tests shall be performed over the frequency range 80 MHz - 1 GHz with the exception of the exclusion bands for transmitter and receiver.

9.1.3.2 Electrostatic discharge (ESD)

The test method shall be in accordance with EN 61000-4-2 [6].

9.1.4 Immunity test levels

Table 8

Clause	Environmental phenomena	Units	Test limits	Basic standard	Performance criteria
9.2.3.1	Electrostatic discharge	kV(charge voltage)	4 (contact discharge) 8 (air discharge)	EN 61000-4-2 [6]	B + subclause 6.3
9.2.3.2	RF electromagnetic field	MHz V/m(rms.)unmod %AM (400 Hz)	80 - 1 000 3 80	ENV 50140 [5]	A + subclause 6.2

9.2 Immunity: DC power input/output port

9.2.1 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in presence of a radio frequency electromagnetic disturbance (common mode) and in the event of fast transients on the dc power input/output port.

9.2.2 Method of measurement

9.2.2.1 Radio frequency electromagnetic disturbance RF common mode, 0,15 MHz - 80 MHz (current clamp injection)

The test method shall be the current clamp injection method in accordance with ENV 50141 [8], except that the following requirements and evaluation of test results shall apply:

- the test shall be performed over the frequency range 150 kHz - 80 MHz with the exception the exclusion bands for transmitter and receiver;
- this test shall be performed at dc power input/output ports, which may have cables longer than three (3) m.

Where this test is not carried out on any port because the manufacturer declares that it is not intended to be used with cables longer than stated above, a list of dc ports which were not tested for this reason shall be included in the test report.

This test shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

9.2.2.2 Fast transients common mode

This test is applicable to base station equipment and ancillary equipment, where the dc power input port cables may be longer than three (3) m. The test method shall be in accordance with EN 61000-4-4 [7]. Where this test is not carried out on any port because the manufacturer declares that it is not intended to be used with cables longer than three (3) m, a list of ports which were not tested for this reason shall be included in the test report.

This test does not apply to input ports intended for connection to a battery or a rechargeable battery which must be removed or disconnected from the equipment for recharging. Equipment with a dc power input port declared for use with an ac/dc power adapter shall be tested on the ac power input side of a typical ac/dc power adapter as declared by the manufacturer (see subclause 5.1).

This test shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

9.2.3 Immunity test levels

Table 9

Clause	Environmental phenomena	Units	Test limits	Basic standard	Performance criteria
9.3.3.1	Fast Transients common mode	kV(peak) Tr/Th ns Rep.Fre.kHz	0.5 5/50 5	EN 61000-4-4 [7]	B + subclause 6.3
9.3.3.2	Radio-Frequency common mode	MHz V(rms, unmod) %AM (400 Hz)	0,15 - 80 3 80	ENV 50141 [8]	A + subclause 6.2

9.3 Immunity: AC power input/output port

9.3.1 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the presence of a radio frequency electromagnetic disturbance, in the event of fast transients and surges and voltage dips and interruptions on the ac power input/output port.

9.3.2 Method of measurement

9.3.2.1 Radio frequency electromagnetic disturbance RF common mode, 0,15 MHz - 80 MHz (current clamp injection)

The test method shall be the current clamp injection method in accordance with ENV 50141 [8], except that the following requirements and evaluation of test results shall apply:

- the test shall be performed over the frequency range 150 kHz - 80 MHz with the exception of the exclusion bands for transmitter and receiver.

This test shall be performed on ac power input/output ports of base station and ancillary equipment for fixed use.

Where this test is not carried out on any ac power output port, because the manufacturer declares that it is not intended to be used with cables longer than three (3) m, a list of ac power output ports which were not tested for this reason shall be included in the test report.

This test shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

9.3.2.2 Fast transients common mode

For transmitters, receivers, transceivers and ancillary equipment connected to the ac mains, the test method shall be in accordance with EN 61000-4-4 [7].

This test is applicable for base station equipment and ancillary equipment for fixed use.

9.3.2.3 Surges common and differential mode

The test method shall be in accordance with EN 61000-4-5 [10].

These tests are applicable for base station and ancillary equipment for fixed use.

These tests shall be performed on ac mains power input ports.

9.3.2.4 Voltage dips and power interruptions

The test method shall be in accordance with EN 61000-4-11 [9].

These tests are applicable for base station and ancillary equipment for fixed use.

These tests shall be performed on ac mains power input ports.

9.3.3 Immunity test levels

Table 10

Clause	Environmental phenomena	Units	Test limits	Basic standard	Performance criteria
9.4.3.1	Radio-Frequency common mode	MHz V(rms, unmod) % AM (400 Hz)	0.15 - 80 3 80	ENV 50141 [8]	A + subclause 6.2
9.4.3.2	Fast Transients common mode	kV(peak) Tr/Th ns Rep frq kHz	1 5/50 5	EN 61000-4-4 [7]	B + subclause 6.3
9.4.3.3	Surges common mode	Tr/Th μ s kV (peak)	1,2/50(8/20) 1	EN 61000-4-5 [10]	B + subclause 6.3
9.4.3.4	Surges Differential mode (line to line).	Tr/Th μ s kV (peak)	1,2/50(8/20) 0.5	ENV 61000-4-5 [10]	B + subclause 6.3
9.4.3.5	Voltage dips	% reduction ms	30 10	EN 61000-4-11 [9]	B + subclause 6.3
9.4.3.6		% reduction ms	60 100	EN 61000-4-11 [9]	C + subclause 6.4
9.4.3.7	Power interruptions	% reduction ms	>95 5 000	EN 61000-4-11 [9]	C + subclause 6.4

9.4 Immunity: Signal /control input/output and antenna port

9.4.1 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in presence of a radio frequency electromagnetic disturbance (common mode) and in the event of fast transients on the signal/control input/output and antenna port.

This test shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment or a representative configuration of the ancillary equipment tested separately from other equipment.

9.4.2 Method of measurement

9.4.2.1 Radio frequency electromagnetic disturbance RF common mode, 0,15 MHz - 80 MHz (current clamp injection)

The test method shall be the current clamp injection method in accordance with ENV 50141 [8], except that the following requirements and evaluation of test results shall apply:

- the test shall be performed over the frequency range 150 kHz - 80 MHz with the exception of the exclusion bands for transmitter and receiver.

This test shall be performed on signal/control input/output and antenna ports of base stations and ancillary equipment for fixed use, which may have cables longer than three (3) m. Where this test is not carried out on any port because the manufacturer declares that it is not intended to be used with cables longer than stated above, a list of signal/control input/output and antenna ports which were not tested for this reason shall be included in the test report.

9.4.2.2 Fast transients common mode

The test method shall be in accordance with EN 61000-4-4 [7].

This test shall be performed on signal/control input/output and antenna ports of base stations and ancillary equipment for fixed use, which may have cables longer than three (3) metres. Where this test is not carried out on any port because the manufacturer declares that it is not intended to be used with cables longer than stated above, a list of ports which were not tested for this reason shall be properly documented in the test report.

9.4.3 Immunity test levels

Table 11

Clause	Environmental phenomena	Units	Test limits	Basic standard	Remarks	Performance criteria
9.5.3.1	RF common mode	MHz V(rms, unmod) %AM (400 Hz)	0,15 - 80 3 80	ENV 50141 [8]	See note	A + subclause 6.2
9.5.3.2	Fast transient common mode	kV (peak) Tr/Th ns Rep frq kHz	0.5 5/50 5	EN 61000-4-4 [7]	Capacitive clamp to be used (see note)	B + subclause 6.3
NOTE: For the test, signal and control port cables can be terminated with an impedance of 150 Ω, antenna port cables shall be terminated with 50 Ω.						

9.5 Immunity: Vehicle dc power input port

9.5.1 Definition

These tests shall assess the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the event of transients and surges present on the dc power input ports in a vehicular environment.

These tests are applicable to mobile and ancillary equipment intended for use in a vehicular environment.

These tests shall be performed on 12 V and 24 V dc power input ports of mobile and ancillary equipment, intended for vehicular use. These test shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

9.5.2 Method of measurement

The test method shall be in accordance with ISO 7637 Part 1 [11] applicable to 12 V dc operated equipment and ISO 7637 Part 2 [11] applicable to 24 V dc operated equipment except that the following requirements and evaluation of test results shall apply:

- equipment designed to operate at both 12 V and 24 V dc without component change, module change or adjustment shall be tested according to subclause 9.7.4;
- equipment designed to operate at both 12 V and 24 V dc but with component change, module change or adjustment shall be tested according to subclauses 9.7.3 and 9.7.4;
- the tests are carried out in all operation modes of the equipment;
- performance criteria B is applied for all tests.

9.5.3 Immunity test levels: 12 V dc powered equipment

Where the manufacturer in his installation documentation requires that the equipment shall have a direct connection to the 12 V main vehicle battery the following pulses apply and the test shall be carried out in accordance with ISO 7637 Part 1 [11] with following characteristics:

Table 12

Clause	Pulse	Level	Pulses	Characteristics	Test time
9.6.3.1	3a	II	5	see ISO 7637-1 [11]	5 min.
9.6.3.2	3b	II	5	see ISO 7637-1 [11]	5 min.
9.6.3.3	4	II	5	Vs = -5V, Va = -2,5V t6 = 25 ms, t8 = 5s, tf = 5 ms	5 min.

Where the manufacturer does not require a direct connection to the 12 V main vehicle battery, the following pulses apply, in addition to the pulses 3a, 3b and 4:

Table 13

Clause	Pulse	Level	Pulses	Characteristics
9.6.3.4	1	II	10	t1 = 2,5s
9.6.3.5	2	II	10	t1 = 2,5s
9.6.3.6	7	II	5	

Where the tests for pulses 1, 2 and 7 are not performed because the manufacturer declares that the equipment requires a direct connection to the vehicle battery, this fact shall be recorded in the test report.

9.5.4 Immunity test levels: 24 V dc powered equipment

Where the manufacturer in his installation documentation requires that the equipment shall have a direct connection to the 24 V main vehicle battery the following pulses apply and the test shall be carried out in accordance with ISO 7637 Part 1 [11] with the following characteristics:

Table 14

Clause	Pulse	Level	Pulses	Characteristics	Test time
9.6.4.1	3a	II	5	see ISO 7637-2 [11]	5 min.
9.6.4.2	3b	II	5	see ISO 7637-2 [11]	5 min.
9.6.4.3	4	II	5	Vs = - 10V, Va = - 5V t6 = 25 ms, t8 = 5s, tf = 5 ms	5 min.

Where the manufacturer does not require a direct connection to the 24 V main vehicle battery, the following pulses apply, in addition to the pulses 3a, 3b and 4:

Table 15

Clause	Pulse	level	Pulses	Characteristics
9.6.4.4	1a	II	10	t1 = 2,5s, Ri = 25 Ohm
9.6.4.5	1b	II	10	t1 = 2,5s, Ri = 100 Ohm
9.6.4.6	2	II	10	t1 = 2,5s

Where the tests for pulses 1a, 1b and 2 are not performed because the manufacturer declares that the equipment requires a direct connection to the vehicle battery, this fact shall be recorded in the test report.

History

Document history	
October 1995	Public Enquiry PE 94: 1995-10-23 to 1996-02-16
April 1996	Converted into Adobe Acrobat Portable Document Format (PDF)